Hochschule für Technik und
Wirtschaft Dresden
University of Applied Sciences

**LDAC2024 - Linked Data in Architecture and Construction**
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# Standard-oriented ontology export of domain catalogues from data dictionaries

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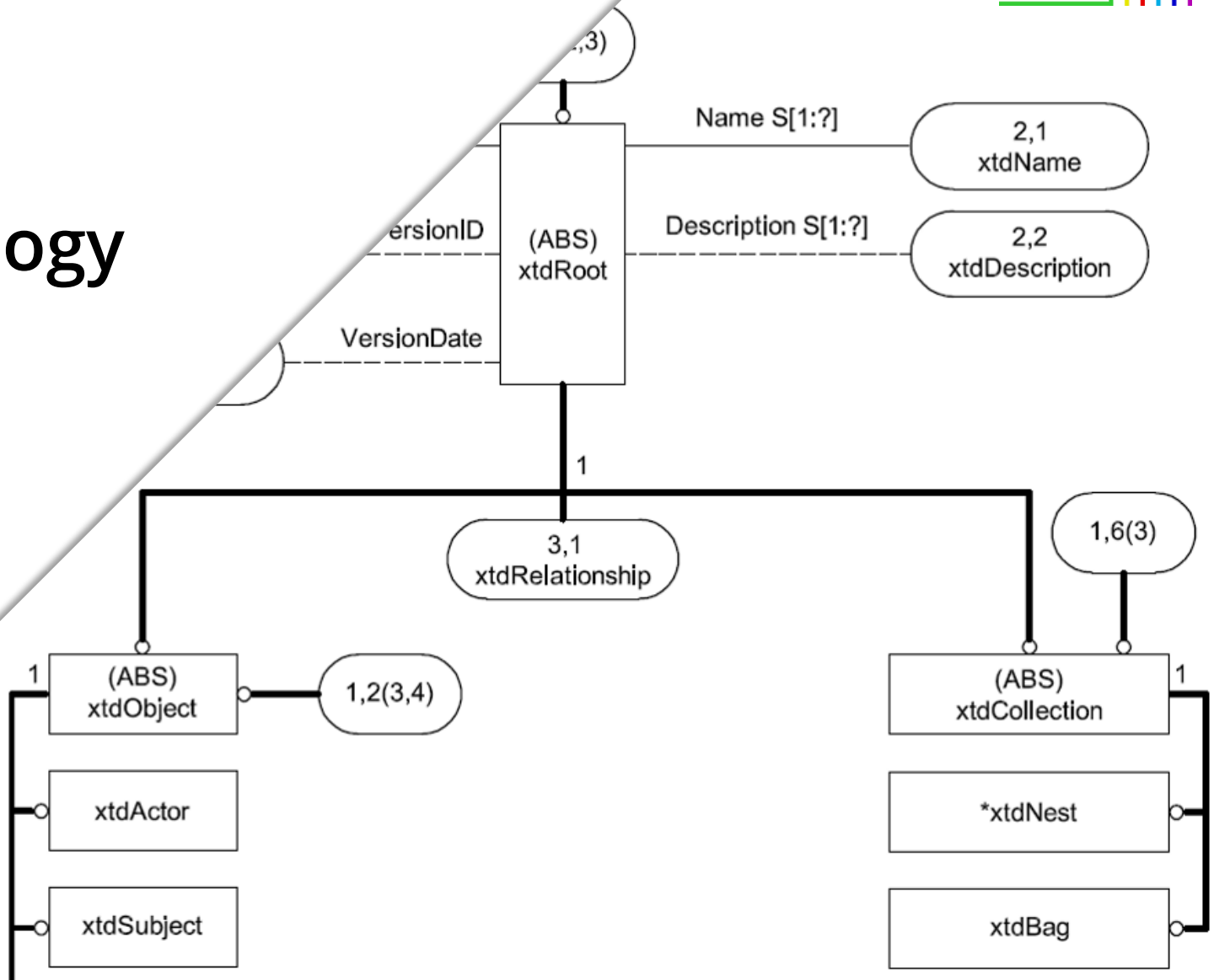


# Introduction

**GIS**

(Geographic Information System)

**ISO 19000 series**

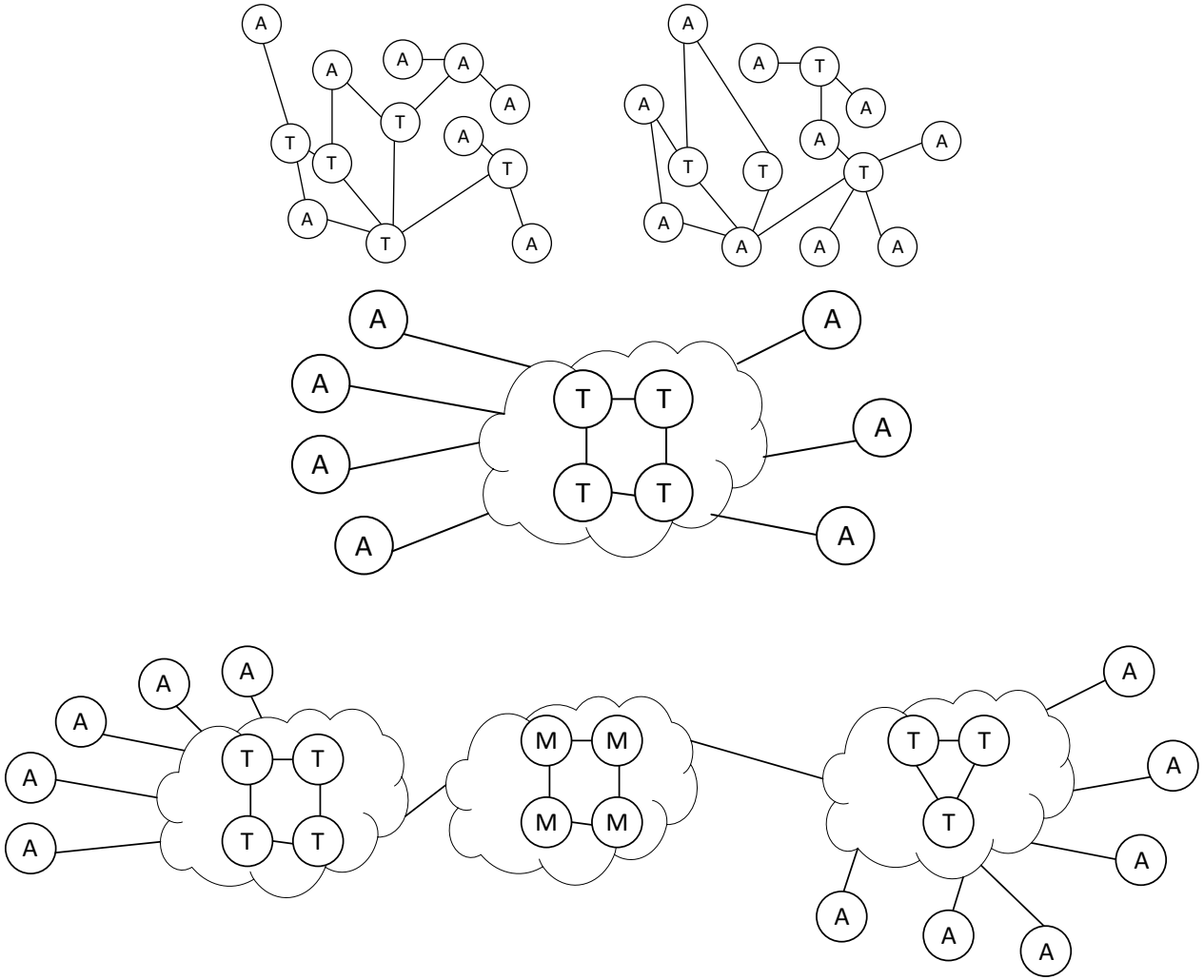
**BIM**

(Building Information Modeling)

**no common standards**

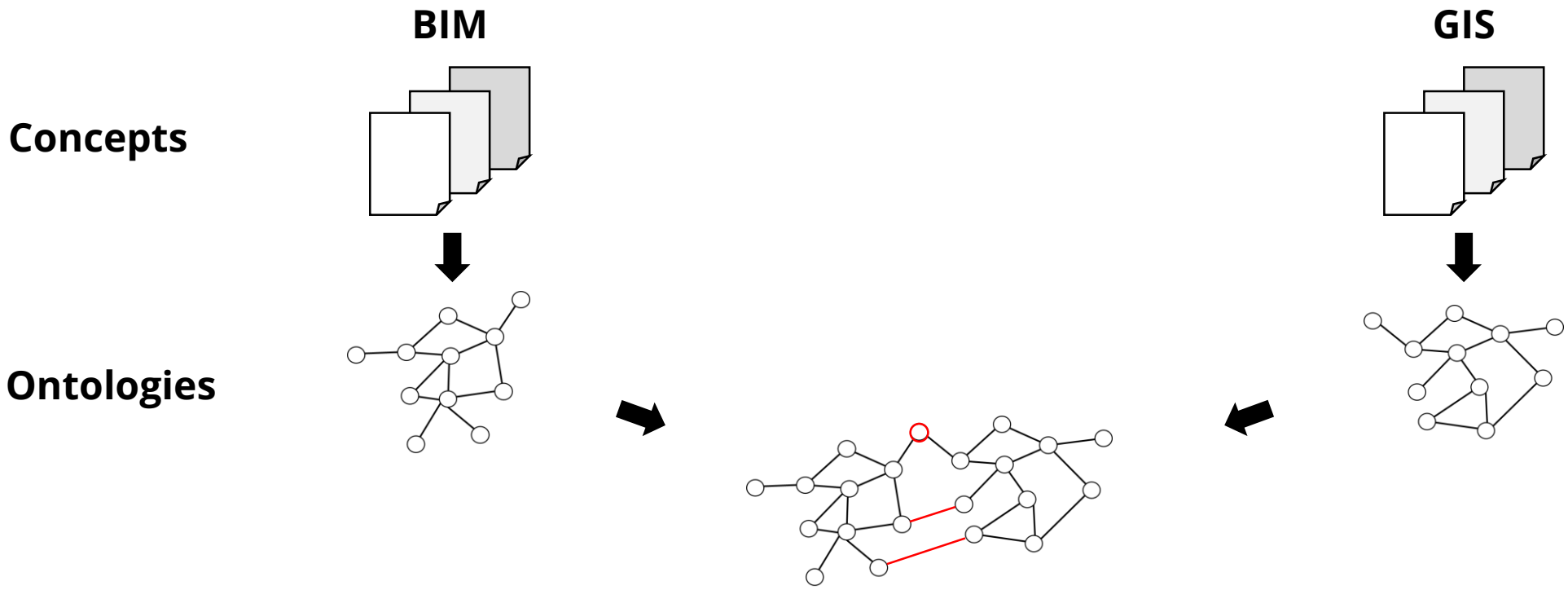
# Benefits of using Data Dictionaries in the Semantic Web

- **Semantic Web**: Schema (T-Box) and data (A-Box) can be stored in the same structure (graph) and system (file/database/service)
- A semantic **dictionary** (T-graph) shall be used by many different systems, the same semantics can be used to query different data
- Many dictionaries (T-graphs) need a common **meta-concept** (M-graph)
- T-graph, M-graph, A-Box are using the **same structure** and systems



# The Idea Behind

**Can Semantic Web technologies help to compare and link data dictionaries from different domains?**



# Related Work - Existing Ontology Export Approaches

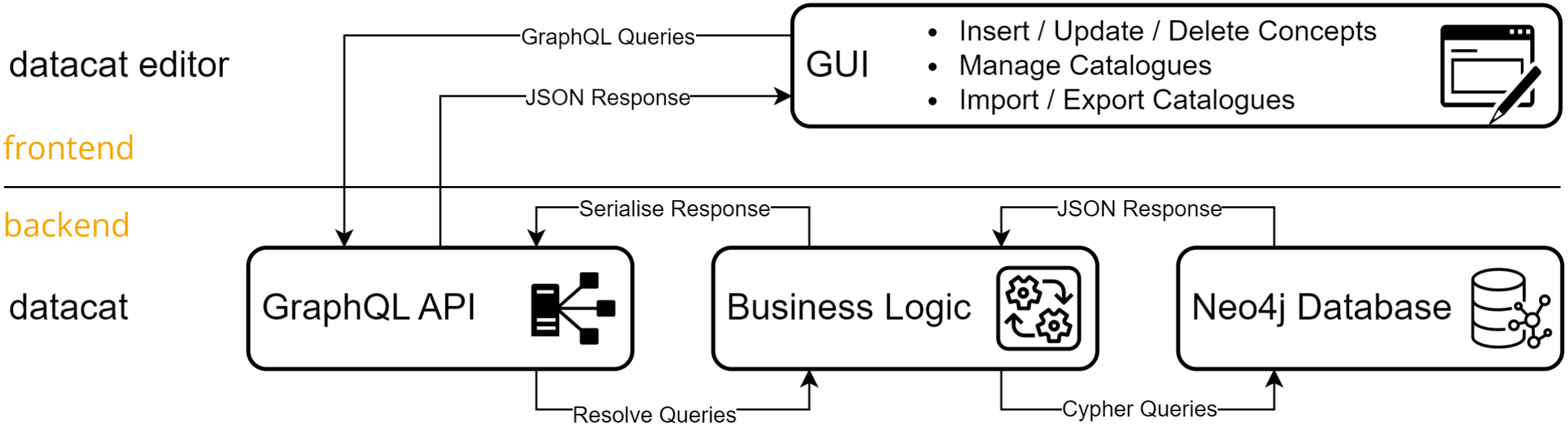
| Paper | Export Level | Source | Method | Exported Concepts |
|---|---|---|---|---|
| Oraskari, 2021 | OWL | bSDD | OpenAPI | IFC property sets + properties |
| Zhang et. al, 2014 | OWL | bSDD | unknown | concepts |
| Pauwels et. al, 2016 | OWL | bSDD | unknown | unknown |
| Wagner & Rüppel, 2019 | no export | bSDD | reference property with bSDD GUID | nothing |
| buildingSMART, 2022 | RDF | bSDD | OpenAPI | classes + properties |

**Differences in our approach:**

- we use our own open-source backend as a source
- we organise our ontology strictly according to ISO 12006-3
- all concepts can be exported from the data dictionary
- we use existing ontologies for the export of meta information

# datacat - Open Source Property Server

**The backend implements the ISO 12006-3:2016 standard**



# datacat - Open Source Property Server

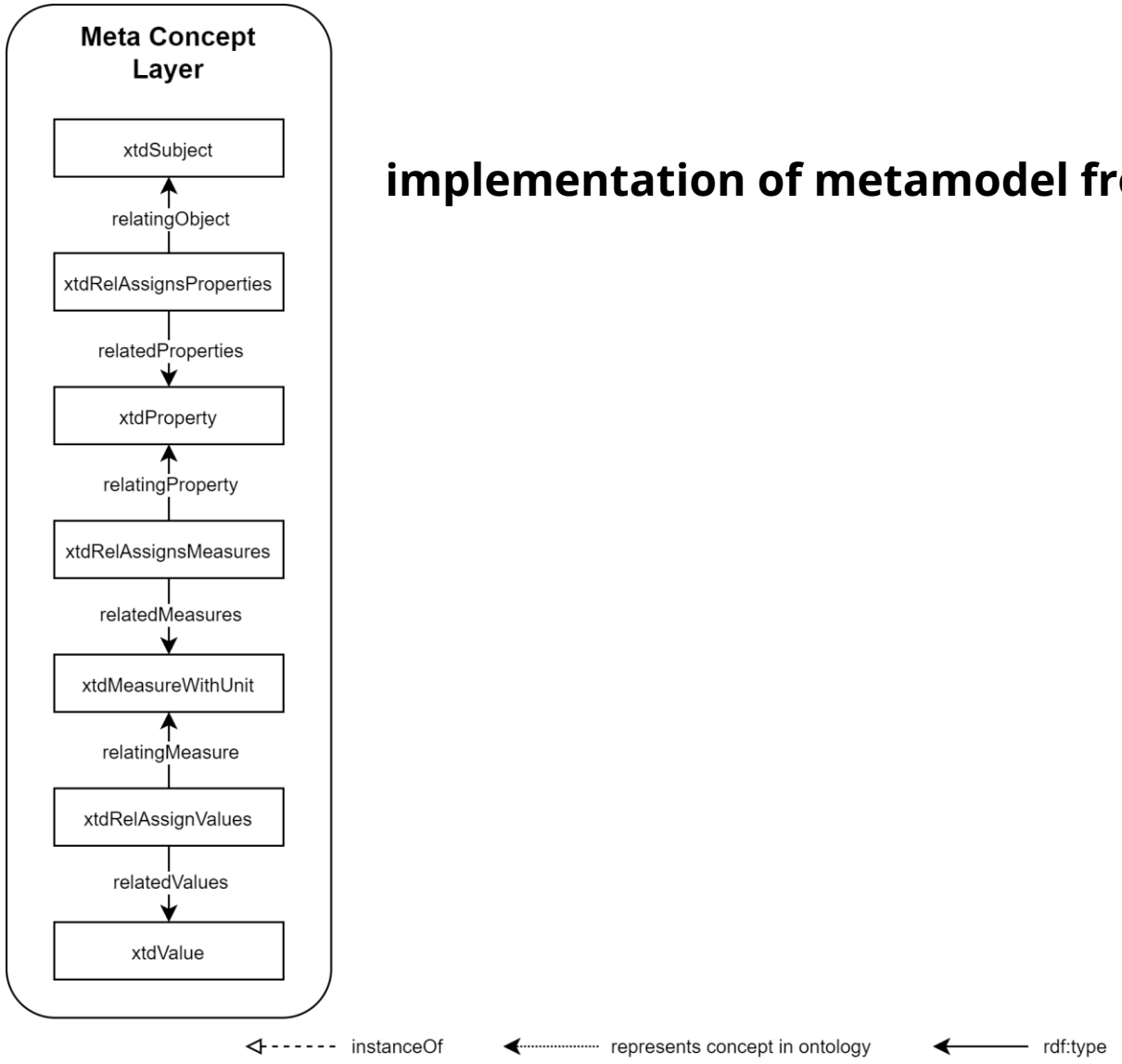

**domain experts and working group**

**datacat: web based collaboration platform**

**BIM / CAD / GIS?**

Source: Managing and publishing standardized data catalogues to support BIM processes, Clemen et al., 2021

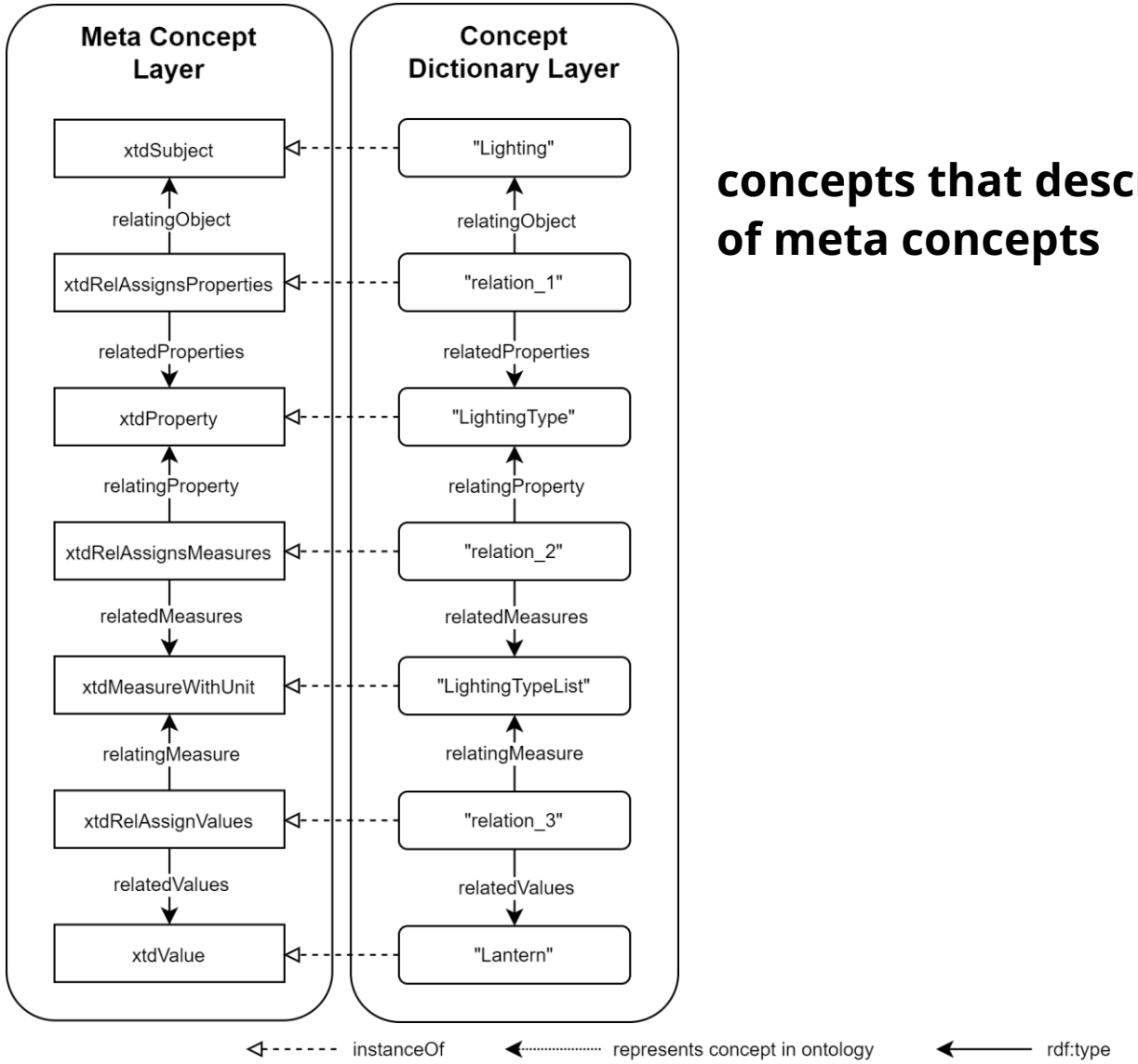
# Layer Structure from Domain Catalogue to Instance




**implementation of metamodel from ISO 12006-3:2016**

based on „Building product catalogues on the semantic web", Beetz & de Vries, 2009

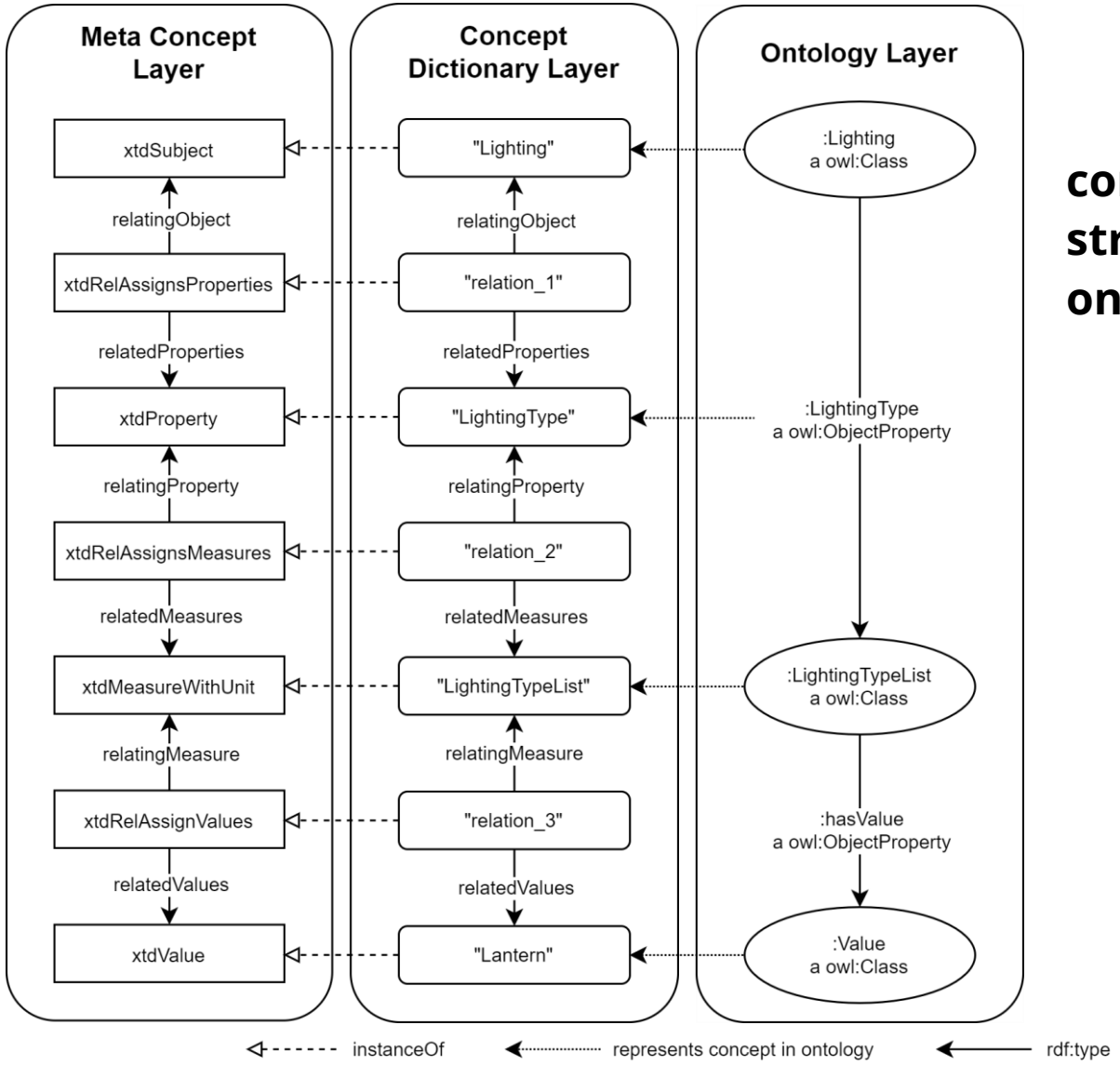
# Layer Structure from Domain Catalogue to Instance




**concepts that describe a domain as instances of meta concepts**

based on „Building product catalogues on the semantic web", Beetz & de Vries, 2009

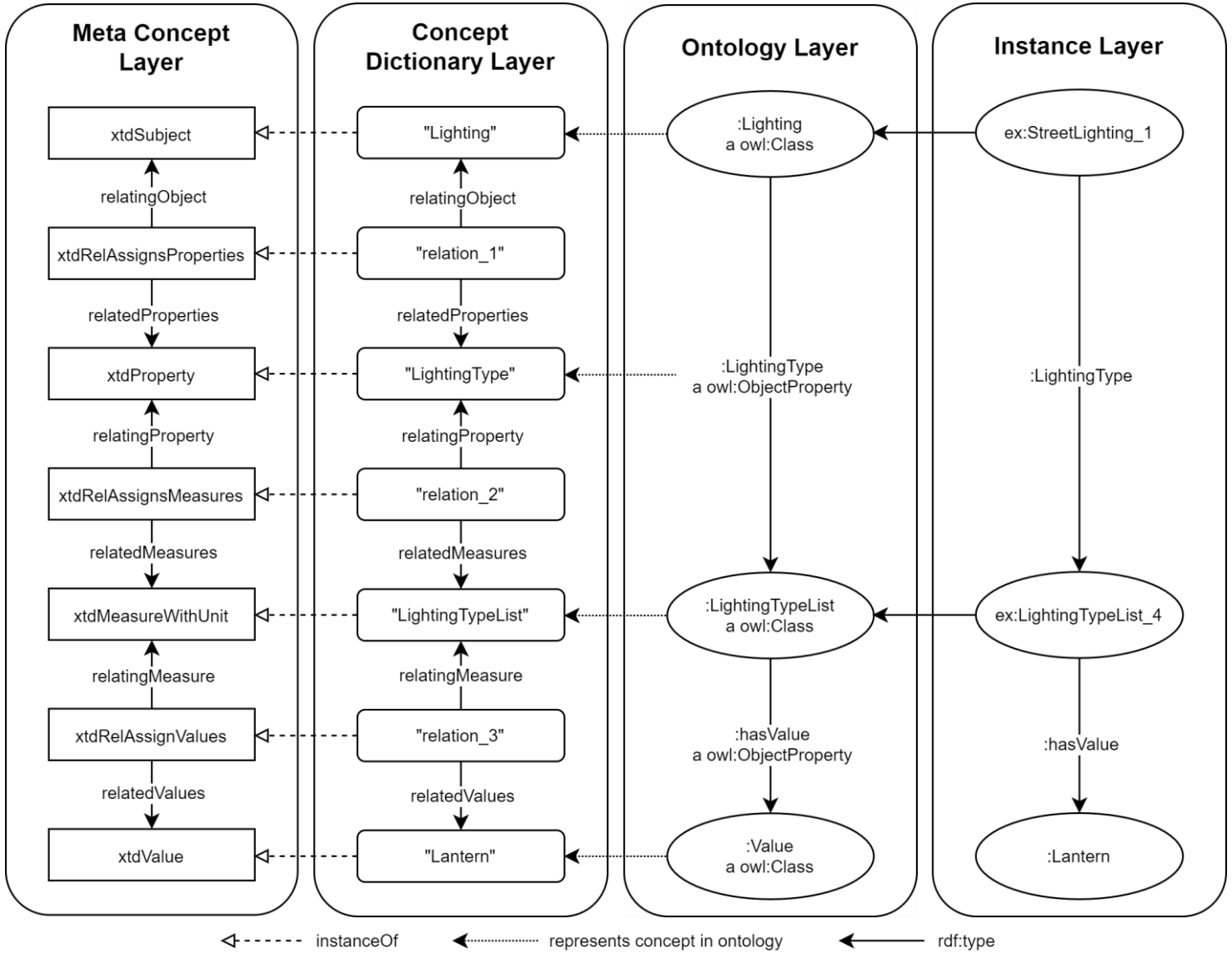
# Layer Structure from Domain Catalogue to Instance




**concepts with meta concept structure represented as ontology**

based on „Building product catalogues on the semantic web", Beetz & de Vries, 2009

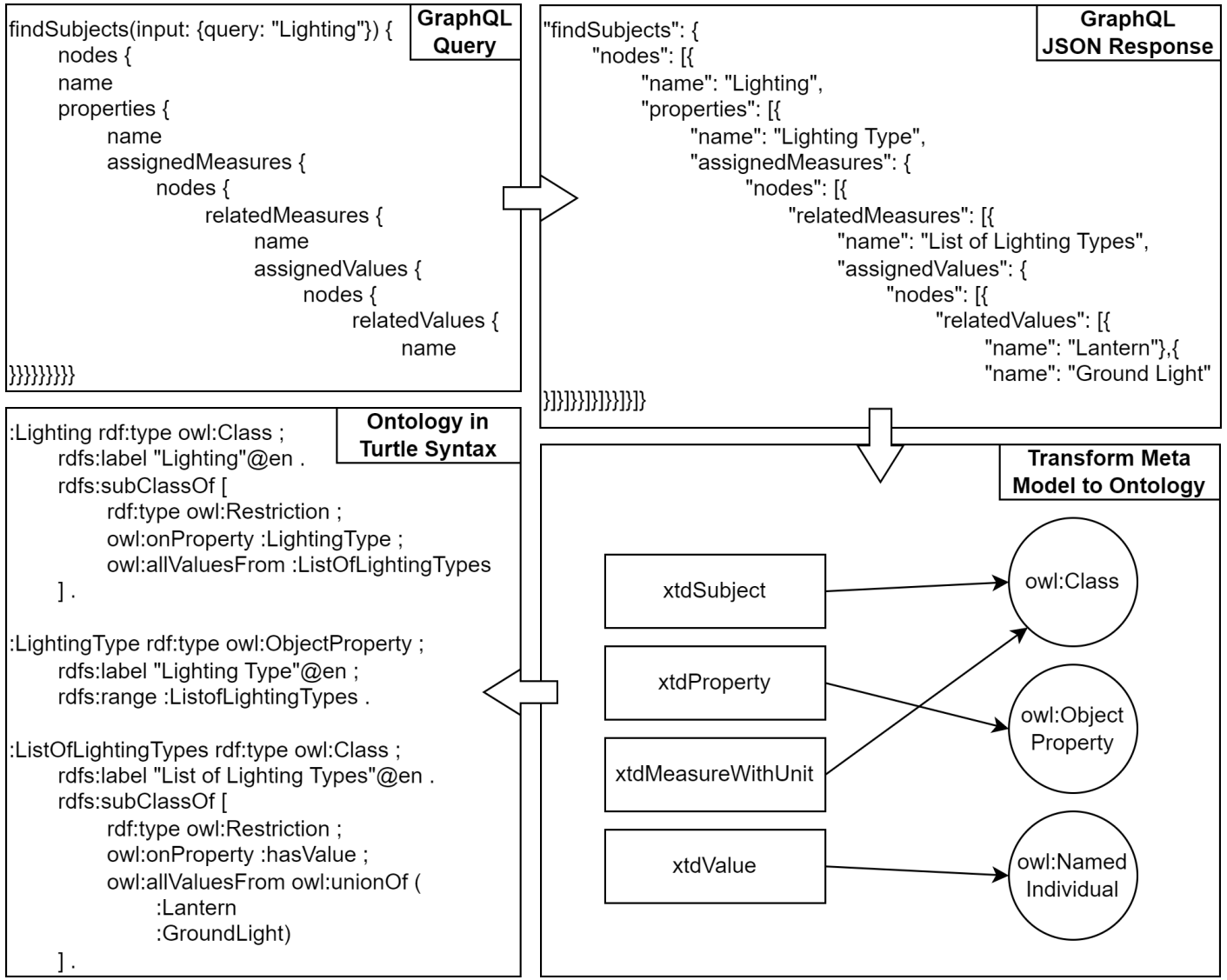
# Layer Structure from Domain Catalogue to Instance




**instances of ontology classes**

based on „Building product catalogues on the semantic web", Beetz & de Vries, 2009

# Ontology Export Processing Sequence



# Standard-based Metadata Properties

- **Dublin Core**
- **RDF Schema**

| Metadata from datacat | Used ontology property |
|---|---|
| name | rdfs:label |
| creator | dcterms:creator |
| created | dcterms:created |
| modified | dcterms:modified |
| description | dcterms:description |
| id | dcterms:identifier |
| ISO 12006-3 concept type | dcterms:type |

**Prefixes**: rdfs: http://www.w3.org/2000/01/rdf-schema\#
dcterms: http://purl.org/dc/terms/

# Restrictions made by Class Axioms

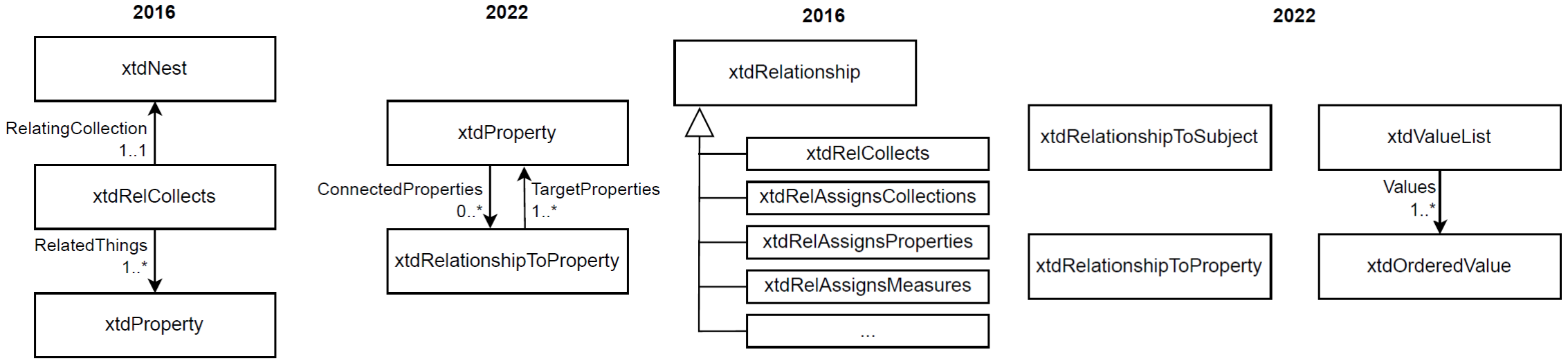
```
:Facilities rdf:type owl:Class ;
   dcterms:type "xtdBag" ;
   rdfs:label "Facilities"@en;
   rdfs:subClassOf [
       rdf:type owl:Restriction ;
       owl:onProperty :collects ;
       owl:allValuesFrom owl:unionOf (:Lighting :Pole :Sign)
   ] .
```

# Metamodel ISO 12006-3 for Comparison

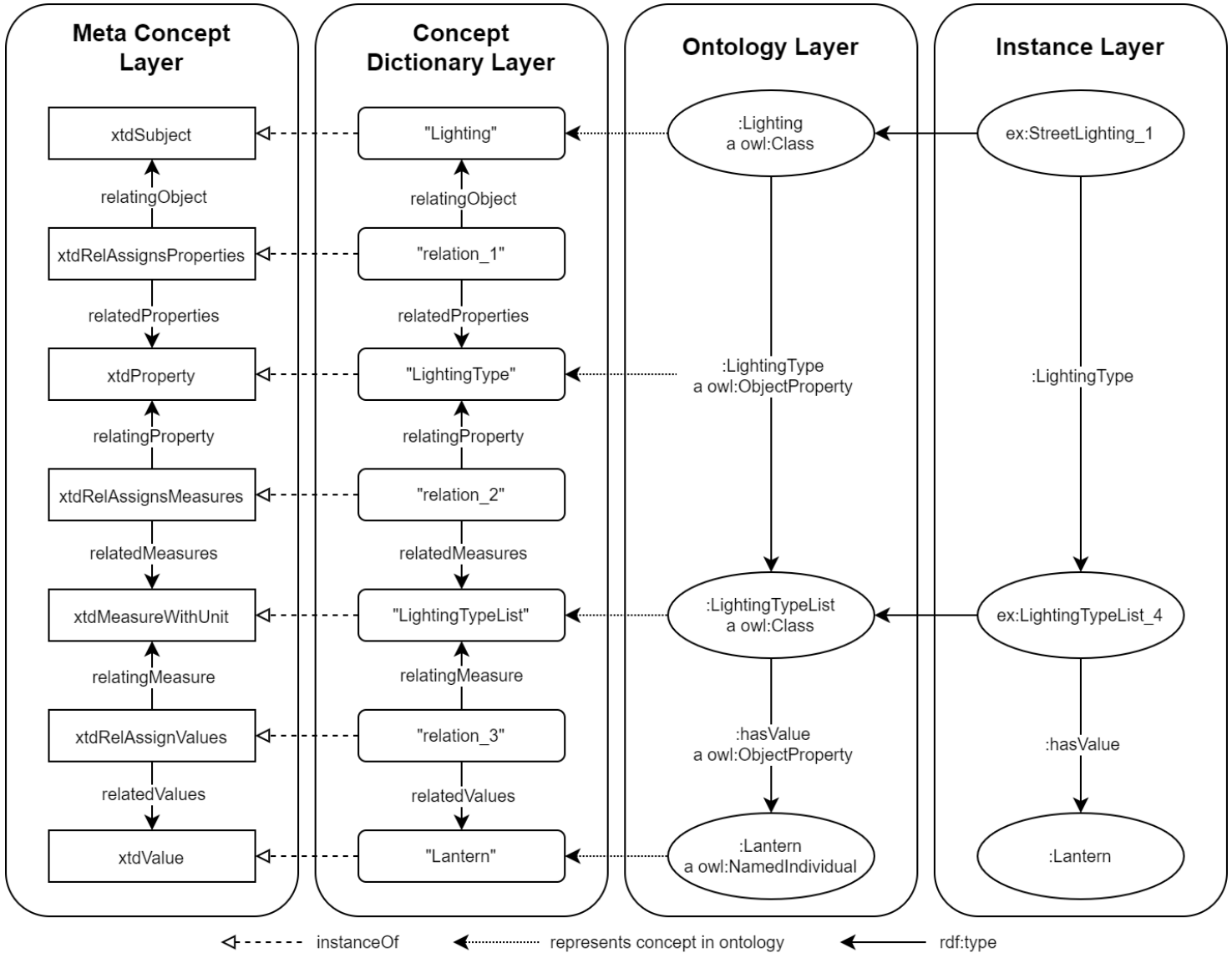
```
:Facilities rdf:type owl:Class ;
   dcterms:type "xtdBag" ;
   rdfs:label "Facilities"@en;
   rdfs:subClassOf [
        rdf:type owl:Restriction ;
        owl:onProperty :collects ;
        owl:allValuesFrom owl:unionOf (:Lighting :Pole :Sign)
   ] .
```

# Update datacat to the new version of ISO 12006-3:2022

– two major changes have a significant impact
  – grouping of concepts (now only for Subjects and Properties)
  – relationships between concepts (simplified relationships)
– many smaller changes that do not have a major impact

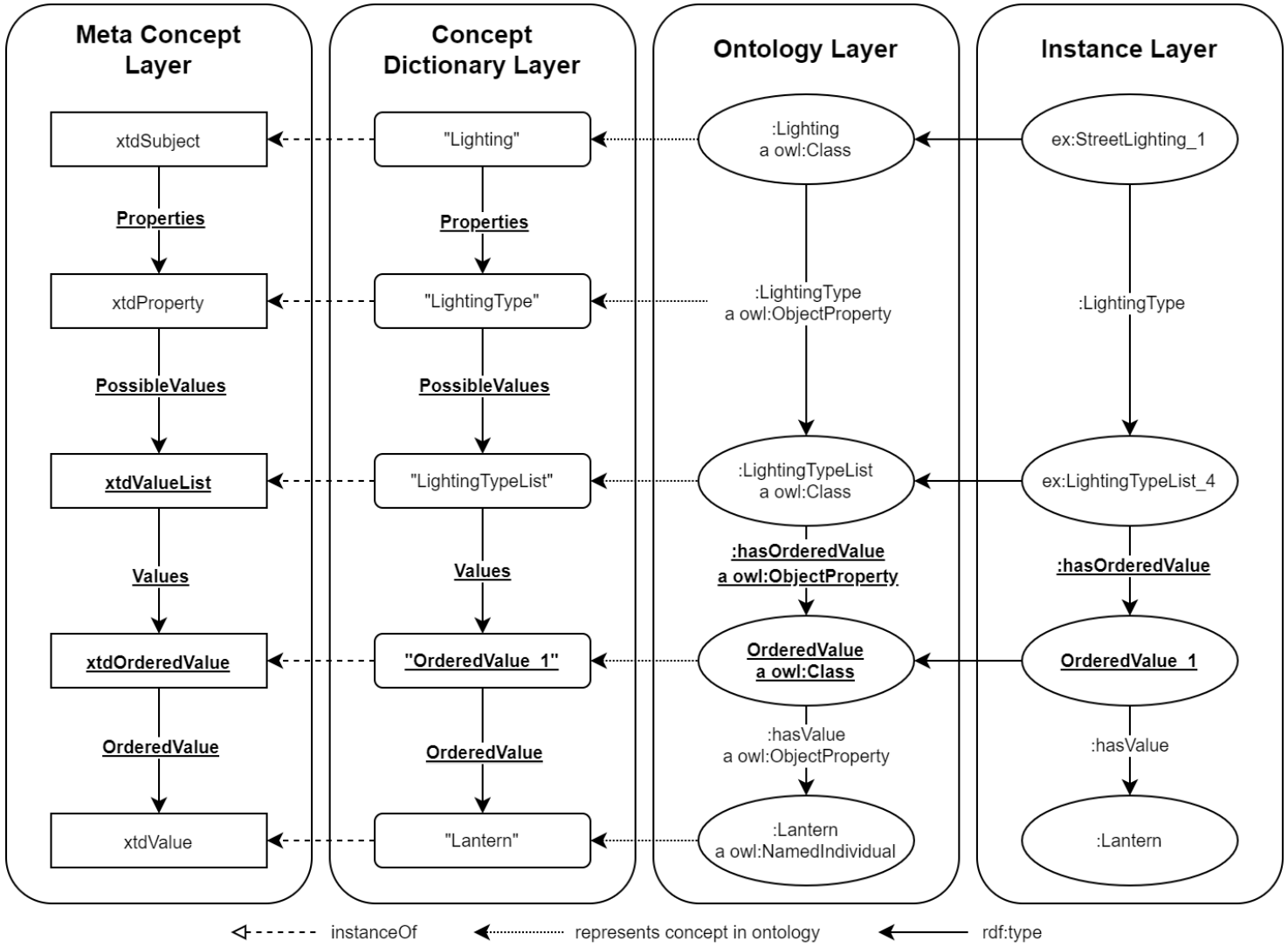


# Outlook - Layer Structure with old ISO 12006-3




based on „Building product catalogues on the semantic web", Beetz & de Vries, 2009

# Outlook - Layer Structure with new ISO 12006-3

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# Results

– property server **exports single concepts / entire data dictionaries** as ontology

– exported ontologies are **classified** and **standardised with metamodel** from ISO 12006-3

– different domain ontologies are **comparable due to equal metamodel**

– **the research provides a technical** and **methodological basis** for a **shared and cross-domain use** of data dictionaries **in BIM and GIS**

# Limitations

– **old ISO 12006-3** standard is used for ontology export

– **not all concepts** for ontology export could be used from **standardised vocabularies**

– **concepts for units and values** in datacat **need to be standardised** for efficient usage and export
  – e.g. Ontology of Units of Measure (OM) should be used

– **GIS data dictionaries are missing in property servers** until now (research objective)

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# Thank you for your attention!

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